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Abel Jansma

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I use machine learning, mathematics, and high-performance computing to understand emergent structures in complex systems. Experience in interdisciplinary teams at the interface of theory, experiment, and computation.

Experience

Postdoctoral Fellow | University of Amsterdam | NL **Nov 2024 - Present**
- Received a 3-year fellowship from the Dutch Institute of Emergent Phenomena to study the foundations and applications of emergence and higher-order structure in complex systems.
- Affiliated to the Institute of Physics (IoP) and the Institute for Logic, Language and Computation (ILLC).

Postdoctoral Researcher | Max Planck Institute for Mathematics in the Sciences | GER **Sep 2023 - Sep 2024**
- In the groups of Jürgen Jost and Bernd Sturmfels, I worked on higher-order information theory, (quantum) generative machine learning, and applications to biology.
- Affiliated with Quantum Informatics at the University of Edinburgh to study parametrised quantum circuits.
- Deployed quantum machine learning code on QVMs (pyQuil, Qiskit) and QPUs (AWS Braket).

Postdoctoral Researcher | University of Edinburgh | UK **Oct 2022 - July 2023**
- Combined generative models, statistical physics, and causal inference to construct hypergraphs of genetic interactions and discovered novel and rare cell identities in populations of up to 100k transcriptomes.
- Inventor and lead R&D of the Stator software package, in an interdisciplinary team across physics, biology, and informatics, combining fundamental research with biomedical applications.

Information Officer | SciPost | NL **Oct 2017 - July 2018**
- Expanded the editorial board, profiling and contacting potential new editors.

Junior Editor | SPUI25 | NL **Feb 2017 - July 2017**
- Co-organised and presented monthly academic & cultural events for a broad audience.

Distillation Engineer | Mediamatic | NL **Sep 2016 - Feb 2017**
- Designed, built, and demonstrated a bespoke 30 litre vacuum still for artistic and olfactory research.

Education

PhD in Biomedical AI | University of Edinburgh | UK **Sep 2018 - Dec 2022**
- Thesis: *Higher-order interactions in single-cell gene expression: Towards a cybergenetic semantics of cell state*
- Supervised by C. Ponting (Genetics and Cancer), L. Del Debbio (Physics), and A. Khamseh (Informatics).
- Graduated from the *Academy for PhD Training in Statistics* at the universities of Cambridge and Oxford.

MSc Theoretical Physics | University of Amsterdam | NL **Sep 2015 - July 2018**
- Thesis: E_8 *symmetry structures in the Ising model* (supervised by B. Nienhuis)
- Visited the Niels Bohr Institute in Copenhagen, Denmark (Feb to Aug 2016), to study nonequilibrium physics and the physics of machine learning.

BSc Physics and Astronomy | University of Amsterdam | NL **Sep 2012 - July 2015**
- Graduated with Honours/Cum Laude and a minor in Computational Science.

Propedeuse in Art and Technology | HKU University of the Arts | NL **Sep 2011 - July 2012**
- Art installations on collective behaviour, exhibited in galleries & festivals in the Netherlands, Germany, and Finland.

Selected Publications & Talks

Articles

- The Fast Möbius Transform: An algebraic approach to information decomposition - Jansma et al (Physical Review Research, 2025)
- A Mereological Approach to Higher-Order Structure in Complex Systems: from Macro to Micro with Möbius - Jansma, A (Physical Review Research, 2025)
- Decomposing Interventional Causality into Synergistic, Redundant, and Unique Components - Jansma (2025)
- High Order Expression Dependencies Finely Resolve Cryptic States and Subtypes in Single Cell Data - Jansma et al. (Molecular Systems Biology, 2025)
- Superdense Coding and Stabiliser Codes with Ising-coupled Entanglement - Jansma, A (2024)
- Higher-Order Interactions and Their Duals Reveal Synergy and Logical Dependence beyond Shannon Information - Jansma, A (Entropy, 2023)
- A Compositional Game to Fairly Divide Homogeneous Cake - Jansma, A (2023)

Conferences

- Higher-order in-and-outeractions - DEMICS23, GER, 2023 (talk)
- A compositional game to fairly divide homogeneous cake - Applied Category Theory 2023 (poster)
- Model-free estimation of higher-order interactions - CSHL Biology of Genomes conference, USA, 2021 (poster)
- Higher-order interactions in single-cell expression data - European Mathematical Genetics Meeting, FR, 2021 (talk)
- Higher-order interactions in single-cell expression data - CSHL Network Biology conference, USA, 2021 (poster)

Invited Talks

- From Macro to Micro with Möbius - UvA Institute for Advanced Studies, NL, 2025
- A Compositional approach to higher-order structure in complex systems - Imperial College London, UK, 2024
- A unified approach to higher-order structure in complex systems - University of Leipzig, GER, 2024
- The information theory of higher-order interactions - UvA Institute for Advanced Studies, NL, 2023
- Complex networks in the mouse brain - IGC Biomed. Genomics, UK, 2021
- Searching for strange loops in mouse brains - Math. Quantum Physics Seminar, University of Innsbruck, AT, 2021
- Higher-order information lattices - Math. Quantum Physics Seminar, University of Innsbruck, AT, 2021

Honours & Awards

Protocol Fellowship Grant | Ethereum Foundation | GER **Nov 2022 - March 2023**

- Research grant in collaboration with the Robust Incentives group and the Institute for Categorical Cybernetics.

Science Communication Grant | Genetics Society | UK **April 2019**

- One of 10 (post-)doctoral researchers nationwide to be awarded funding for science communication training.

Technology Scholarship | ASML | NL **Sep 2015 - Sep 2017**

- One of 25 graduate students nationwide awarded a two-year professional development scholarship.

Volunteering

Co-host | Computational Biology Journal Club **Feb 2019 - March 2020**

Beekeeper | Anna's Tuin en Ruigte **Oct 2017 - July 2018**

Reader | VoorleesExpress **Nov 2016 - Nov 2017**

- I read books to children to stimulate language development and promote reading.

Committee member | BetaBreak **Dec 2014 - Jan 2016**

- Moderated and organised public debates on science & society at Amsterdam Science Park.

Languages

Natural	Dutch (native), English (fluent), German (fluent), French (basic)
Programming	Python (SciPy, PyTorch, Qiskit, *etc.*), R, Nextflow, SGE, Git, Haskell, Arduino (C++)